General Specifications

Item	Specification
Normal engine cranking speed rpm	100-140 rpm
Starter motor no load current draw amperes	60-80 amps
Starter motor normal load current draw	130 amps
Starter motor maximum load current draw amperes	400 amps
Maximum starting circuit voltage drop (engine at normal engine temperature)	0.5 volt

Torque Specifications

Description	Nm	lb-ft	lb-in
Starter motor bolts	25	18	—
Starter motor ground cable nut	25	18	—
Starter motor solenoid S terminal nut	6	—	53
Starter motor solenoid B terminal nut	12	9	—

Starting System

Starter Motor

The starter motor is a 12-volt unit that has the starter solenoid mounted on the drive end housing and functions as follows:

- The current flows through the solenoid energizing coil until the solenoid plunger is at the end of its travel.
- The plunger closes a set of contacts that bypass the energizing coil, letting the holding coil keep the starter drive engaged and passing starting current to the starter motor.
- The motor is energized when the starter solenoid contacts are closed.
- The starter drive engages the flywheel ring gear and starts the engine.
- An overrunning clutch in the starter drive protects the starter motor from excessive speed when the engine starts.

Starter Relay

The starter interrupt relay consists of:

- pull in coil and contacts

When the ignition switch is in the START position:

- the pull-in coil is activated and pulls the contacts together.
- current passes through the starter relay from the engine compartment power distribution box to the starter solenoid.

Clutch Pedal Position (CPP) Switch

The CPP switch for:

- a manual transmission closes when the clutch pedal is depressed, completing the starting circuit.
- an automatic transmission is a jumper inserted in place of the CPP switch to complete the circuit.

Starter System — Operation

When the ignition switch is turned to the START position the starter relay switches power to the starter solenoid causing the starter motor to engage as long as:

- the clutch pedal is depressed (manual transmission only).
- the digital transmission range (TR) sensor is in PARK or NEUTRAL (automatic transmission only).

Starting System

Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

Special Tool(s)

ST1137-A	Digital Multimeter 105-R0051 or equivalent

Inspection and Verification

WARNING: When servicing starter motor or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions may result in personal injury.

WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components. Failure to follow these instructions may result in personal injury.

WARNING: When using a remote starter switch or jumper wire, be sure the ignition switch is in the OFF position and the transmission is in PARK (A/T) or Neutral (M/T) with the parking brake control fully applied.

1. Verify the customers concern by operating the starting system to duplicate the conditions.
2. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical
● Starter motor ● Brackets	● Battery ● Battery junction box (BJB) fuse ignition switch (40A) ● Central junction box (CJB) Fuse 6 (20A) ● Fuse 24 (10A) ● Damaged wiring harness ● Starter Relay ● Loose or corroded connections

3. If the inspection reveals an obvious concern that can be readily identified, repair as necessary.
4. If the concern remains after the inspection, determine the symptom. GO to Symptom Chart .

Symptom Chart

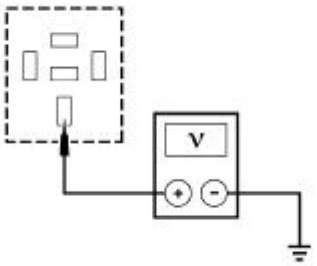
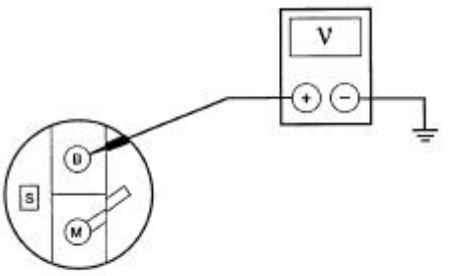
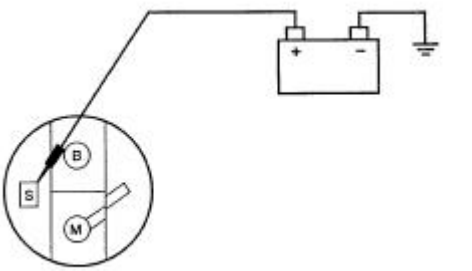
SYMPTOM CHART

Condition	Possible Sources	Action
● The engine does not crank and the relay does click	● Battery. ● Fuse. ● Starter motor/solenoid. ● Ignition switch. ● Circuit.	● Go To Pinpoint Test A .
● The engine does not crank and the relay does not click	● Fuse. ● Battery. ● Starter relay. ● Ignition switch. ● Digital transmission range (TR) sensor. ● Starter solenoid. ● Clutch pedal position (CPP) switch. ● Circuit.	● Go To Pinpoint Test B .
● The engine cranks slowly	● Battery. ● Starter motor/solenoid. ● Circuit.	● Go To Pinpoint Test C .
● Unusual starter noise	● Starter motor mounting. ● Starter motor. ● Incorrect starter drive engagement.	● Go To Pinpoint Test D .
● The starter spins but the engine does not crank	● Starter Motor ● Damaged flywheel/ring gear teeth.	● INSPECT the starter motor mounting and engagement. REPAIR as necessary. ● INSPECT the flywheel/ring gear for damaged, missing or worn teeth. REPAIR as necessary.

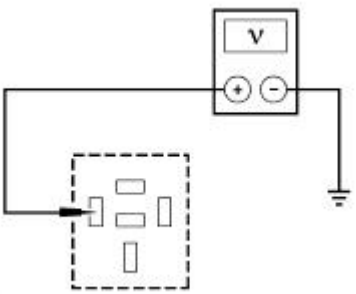
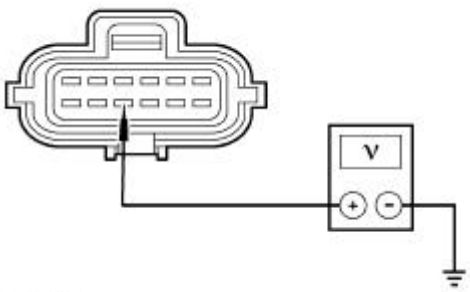
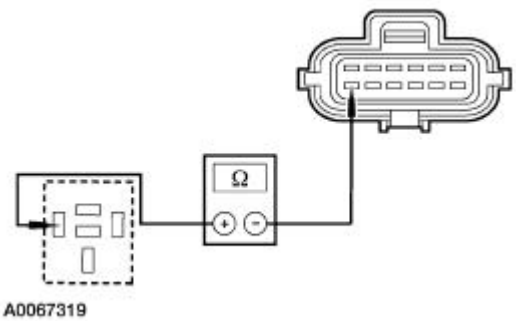
Pinpoint Tests

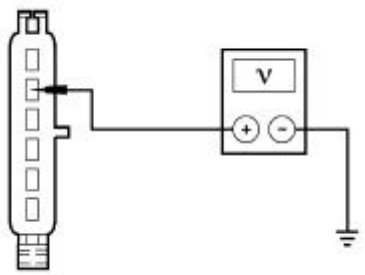
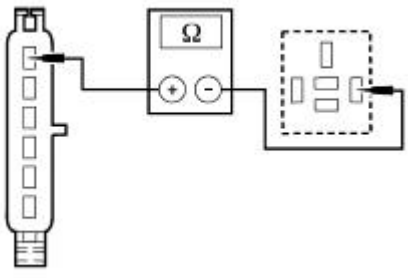
PINPOINT TEST A: THE ENGINE DOES NOT CRANK AND THE RELAY DOES CLICK

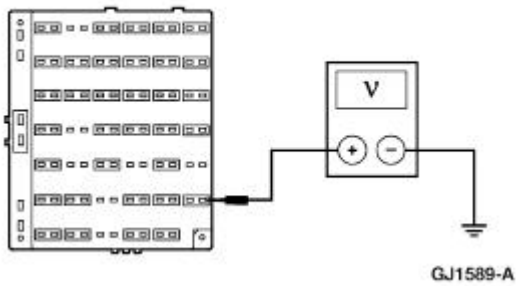
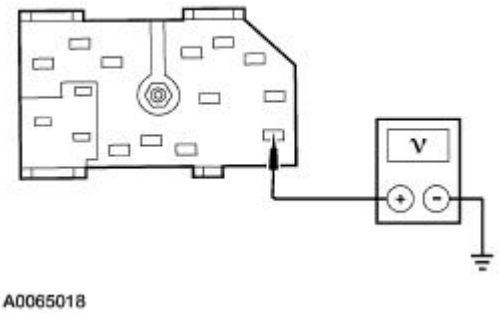
Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE STARTER RELAY	
● Measure the voltage between the starter relay pin 30, circuit 1050 (LG/VT) and ground.	**Yes** GO to A2 . **No** REPAIR circuit 1050 (LG/VT)

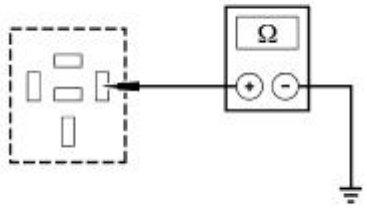
 A0032573 ● **Is the voltage greater than 12.5 volts?**	for an open. TEST the system for normal operation.
A2 CHECK THE VOLTAGE TO THE STARTER MOTOR SOLENOID	
● Measure the voltage between the starter motor solenoid positive terminal and ground.  J6079-A ● **Is the voltage 12.5 volts or greater?**	**Yes** GO to A3 . **No** REPAIR circuit 2037 (RD) for an open. TEST the system for normal operation.
A3 MANUALLY JUMP THE STARTER MOTOR	
● Connect one end of a fused (15A) jumper wire to the positive terminal of the battery and touch the other end to the starter solenoid S-terminal.  J6080-A ● **Does the starter solenoid engage?**	**Yes** GO to A4 . **No** INSTALL a new starter motor. REFER to Starter Motor—3.8L or Starter Motor—4.6L . TEST the system for normal operation.
A4 TEST THE STARTER MOTOR RELAY	
● Carry out the relay component test on the starter motor relay. Refer to the relay component test in this section. ● **Does the starter motor relay test good?**	**Yes** REPAIR circuit 33 (WH/PK)/262 (BN/PK) for an open. TEST the system for normal operation. **No** INSTALL a new starter motor relay. TEST the system for normal operation.

PINPOINT TEST B: THE ENGINE DOES NOT CRANK AND THE RELAY DOES NOT CLICK

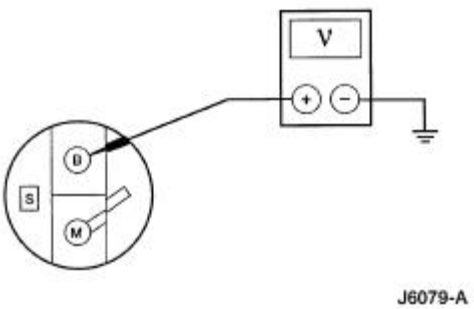
Test Step	Result / Action to Take
B1 CHECK CIRCUIT 33 (WH/PK) FOR VOLTAGE ● Disconnect: Starter Motor Relay. ● Key in START position. ● Measure the voltage between the starter motor relay pin 85, circuit 33 (WH/PK) and ground while holding the key in the START position.  A0013862 ● **Is the voltage greater than 10 volts?**	**Yes** GO to B10 . **No** For automatic transmissions, GO to B2 . For manual transmissions, GO to B5 .
B2 CHECK CIRCUIT 32 (RD/LB) FOR VOLTAGE AT THE DIGITAL TR SENSOR ● Key in OFF position. ● Disconnect: Digital TR Sensor C110. ● Key in START position. ● Measure the voltage between the digital TR sensor C110 pin 10, circuit 32 (RD/LB) and ground while holding the key in the START position.  A0065013 ● **Is the voltage greater than 10 volts?**	**Yes** GO to B3 . **No** GO to B7 .
B3 CHECK CIRCUIT 33 (WH/PK) FOR OPEN ● Key in OFF position.  A0067319 ● Measure the resistance between the digital TR sensor C110 pin	**Yes** GO to B4 . **No** REPAIR circuit 33 (WH/PK). TEST the system for normal operation.

12, circuit 33 (WH/PK) and the starter motor relay pin 86, circuit 33 (WH/PK). ● **Is the resistance less than 5 ohms?**	
B4 CHECK DIGITAL TRANSMISSION RANGE (TR) SENSOR ADJUSTMENT	
● Carry out the digital TR sensor adjustment. Refer to Section 307-01 . ● **Is the digital TR sensor adjusted correctly?**	**Yes** INSTALL a new digital TR sensor. TEST the system for normal operation. **No** ADJUST the digital TR as necessary. TEST the system for normal operation.
B5 CHECK CIRCUIT 32 (RD/LB) FOR VOLTAGE AT THE CLUTCH SWITCH OR JUMPER	
● Key in OFF position. ● Disconnect: Clutch Pedal Switch C255. ● Key in START position. ● Measure the voltage between the clutch pedal switch C255 pin 2, circuit 32 (RD/LB) and ground while holding the key in the START position.  A0067320 ● **Is the voltage greater than 10 volts?**	**Yes** GO to B6 . **No** GO to B7 .
B6 CHECK CIRCUIT 33 (WH/PK)/32 (RD/LB) FOR OPEN	
● Key in OFF position. ● Measure the resistance between the clutch pedal switch C255 pin 1, circuit 33 (WH/PK)/32 (RD/LB) and the starter motor relay pin 86, circuit 33 (WH/PK)/32 (RD/LB).  A0067321 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new clutch pedal switch. TEST the system for normal operation. **No** REPAIR circuit 33 (WH/PK)/32 (RD/LB). TEST the system for normal operation.
B7 CHECK FOR VOLTAGE AT FUSE 6	
● Key in OFF position. ● Disconnect: Fuse #6. ● Key in START position.	**Yes** REPAIR circuit 32 (RD/LB). TEST the

• Measure the voltage between the central junction box fuse 6, circuit 33 (WH/PK) and ground while holding the key in the START position.  GJ1589-A • **Is the voltage greater than 10 volts?**	system for normal operation. **No** GO to B8 .
B8 CHECK CIRCUIT 1050 (LG/VT) FOR VOLTAGE	
• Key in OFF position. • Disconnect: Ignition Switch C209. • Key in ON position. • Measure the voltage between the ignition switch connector C209 pin B4, circuit 1050 (LG/VT) and ground.  A0065018 • **Is the voltage greater than 10 volts?**	**Yes** GO to B9 . **No** REPAIR circuit 1050 (LG/VT). TEST the system for normal operation.
B9 CHECK THE IGNITION SWITCH	
• Carry out the ignition switch component test. Refer to Refer to Wiring Diagrams Cell 149 for schematic and connector information. . • **Does the ignition switch test good?**	**Yes** REPAIR circuit 33 (WH/PK). TEST the system for normal operation. **No** INSTALL a new ignition switch. TEST the system for normal operation.
B10 CHECK CIRCUIT 1205 (BK) FOR OPEN	
• Key in OFF position.	**Yes** INSTALL a new starter motor relay. TEST the system for normal operation. **No** REPAIR circuit 1205 (BK). TEST the system for normal operation.

 A0013858 ● Measure the resistance between the starter motor relay pin 86, circuit 1205 (BK) and ground. ● **Is the resistance less than 5 ohms?**	

PINPOINT TEST C: THE ENGINE CRANKS SLOWLY

Test Step	Result / Action to Take
NOTE: Before beginning this test, be sure that the battery is tested and fully charged.	
C1 CHECK THE VOLTAGE TO THE STARTER ● Key in OFF position. ● Measure the voltage between the starter motor solenoid positive terminal and ground.  J6079-A ● **Is the voltage 12.5 volts or greater?**	**Yes** GO to C2 . **No** REPAIR the circuit between the battery and the starter solenoid. CLEAN and TIGHTEN the connections at the battery terminals. TEST the system for normal operation.
C2 CHECK MOTOR GROUND CIRCUIT ● Carry out the Motor Ground Circuit test; refer to Component Tests in this section. ● **Is the ground OK?**	**Yes** INSTALL a new starter motor. REFER to Starter Motor—3.8L or Starter Motor—4.6L . TEST the system for normal operation. **No** REPAIR the ground circuit as necessary. TEST the system for normal operation.

PINPOINT TEST D: UNUSUAL STARTER NOISE

Test Step	Result / Action to Take
D1 CHECK THE STARTER MOTOR MOUNTING	
● Inspect the starter motor mounting	**Yes**

brackets for cracks. • Check the starter motor mounting bolts for looseness. • **Is the starter motor mounted correctly?**	GO to D2 . **No** REINSTALL the starter motor correctly. REFER to Starter Motor—3.8L or Starter Motor—4.6L in this section.
D2 INSPECT THE STARTER MOTOR • Remove the starter motor; refer to Starter Motor—3.8L or Starter Motor—4.6L in this section. • Inspect the starter motor for damage. • **Is the starter motor damaged?**	**Yes** INSTALL a new starter motor. REFER to Starter Motor—3.8L or Starter Motor—4.6L in this section. TEST the system for normal operation. **No** CHECK the starter drive. REFER to Component Tests, Starter Drive Test in this section. INSTALL a new starter motor. TEST the system for normal operation.

Component Tests

Starter Motor —Voltage Drop Test

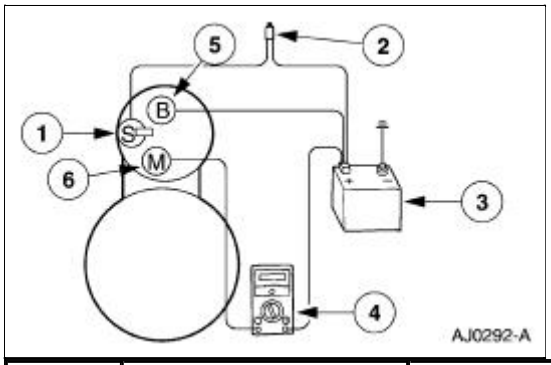
WARNING: When servicing starter motor or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions may result in personal injury.

WARNING: When using a remote starter switch or jumper wire, be sure the ignition switch is in the OFF position and the transmission is in PARK (A/T) or Neutral (M/T) with the parking brake control fully applied.

Always make the Digital Multimeter connections at the component terminal rather than at the wiring end connector. Making a connection at the wiring end connector could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

Starter Motor—Motor Feed Circuit

1. Make sure the battery is fully charged. Perform a battery load test. For additional information, refer to Section 414-00 .
2. Disconnect the inertia fuel shut off (IFS) switch.
3. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.
4. Connect the Digital Multimeter positive lead to the battery positive (+) post. Connect negative lead to the starter solenoid M-terminal.

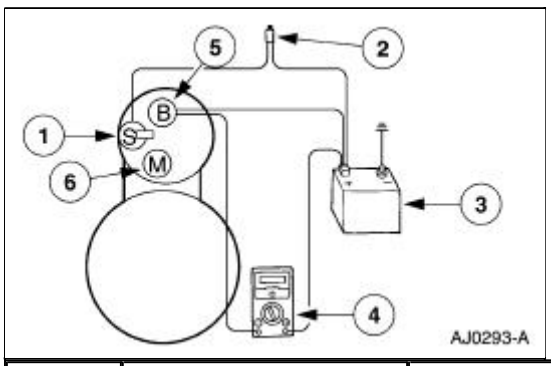


Item	Part Number	Description
1	—	S-terminal
2	—	Remote starter switch
3	10653	Battery
4	—	Digital multimeter
5	—	B-terminal
6	—	M-terminal

5. Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.5 volt or less.

6. If the voltage reading is less than 0.5 volts, go to the Starter Motor-Ground Circuit Component Test.

7. If the voltage reading is greater than 0.5 volts, this an indication of excessive resistance in the connections, the positive battery cable or in the starter solenoid. Move the Digital Multimeter negative lead to the starter solenoid B-terminal and repeat the test. If the voltage reading at the B-terminal is less than 0.5 volts, the concern is either in the connections at the starter solenoid or in the solenoid contacts. Go to Step 8. If the voltage reading is greater than 0.5 volts at the B-terminal, the concern is either the positive battery cable or connections. Go to Step 9.



Item	Part Number	Description
1	—	S-terminal
2	—	Remote starter switch
3	10653	Battery
4	—	Digital multimeter
5	—	B-terminal
6	—	M-terminal

8. Remove the cables from solenoid B-, S- and M-terminals. Clean the cables and connections and reinstall the cables to the correct terminals. Repeat Steps 3 through 6. If the voltage drop

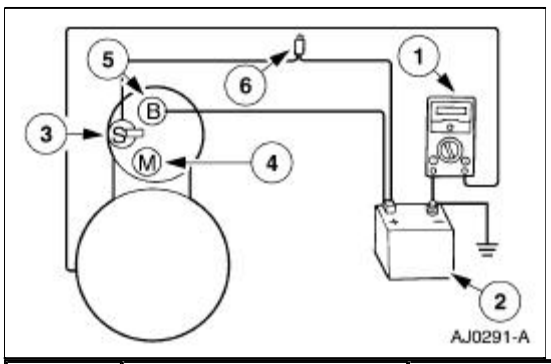
reading is still greater than 0.5 volts when checked at the M-terminal and less than 0.5 volts when checked at the B-terminal, the concern is in the solenoid contacts. Install a new starter motor. Refer to Starter Motor—3.8L or Starter Motor—4.6L .

9. Clean the positive (+) battery cable connections. Repeat the test at the starter solenoid B terminal. If the voltage is greater than 0.5 volts, install a new positive battery cable.

Starter Motor—Ground Circuit

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Connect the Digital Multimeter positive lead to the starter motor housing (the connection must be clean and free of rust or grease). Connect the negative lead to the negative (-) battery terminal.



Item	Part Number	Description
1	105-R0057	Digital multimeter
2	10653	Battery
3	—	S-terminal
4	—	M-terminal
5	—	B-terminal
6	—	Remote starter switch

2. Engage the remote starter switch. Read and record the voltage. The voltage reading should be less than 0.3 volts.

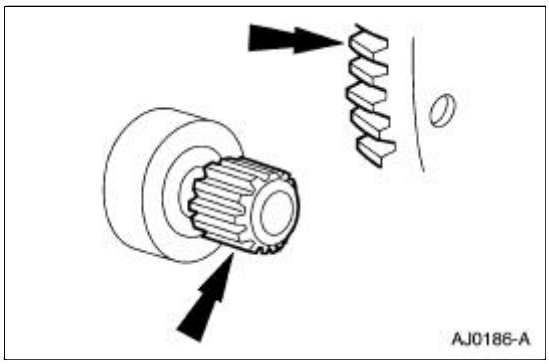
3. If the voltage is greater than 0.3 volts, clean the negative cable connections at the battery, body ground connections, and the starter ground connections. Retest.

4. If the voltage is greater than 0.3 volts, install a new cable. If the voltage reading is less than 0.2 volts and the engine still cranks slowly, install a new starter motor. Refer to Starter Motor—3.8L or Starter Motor—4.6L .

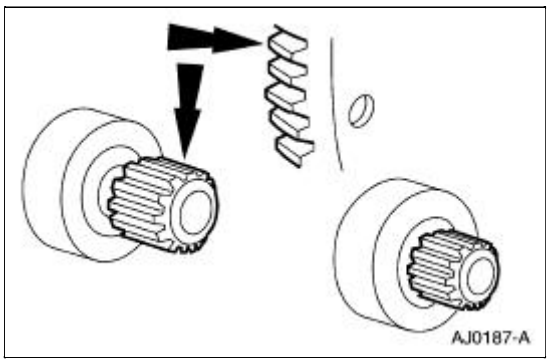
Starter Drive and Flywheel Ring Gear Inspection

1. Remove the starter motor. For additional information, refer to Starter Motor—3.8L or Starter Motor—4.6L in this section.

2. Check the wear patterns on the starter drive gear and the flywheel ring gear . If the wear pattern is normal, install the starter motor. For additional information, refer to Starter Motor—3.8L or Starter Motor—4.6L in this section.

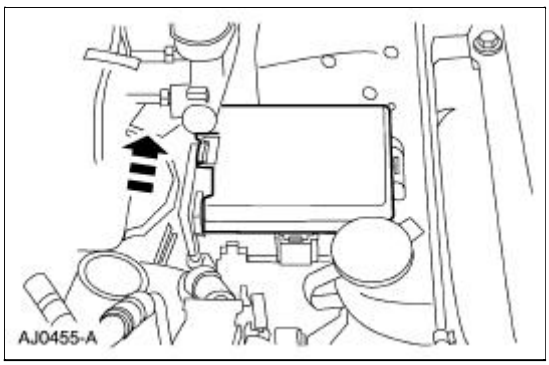


3. If the starter drive gear and the flywheel ring gear are not fully meshing and both of the gears are scored or damaged, install a new starter motor. For additional information refer to Starter Motor—3.8L or Starter Motor—4.6L in this section.
If necessary, install a new flywheel. For additional information, refer to Section 303-01A or section Section 303-01B .

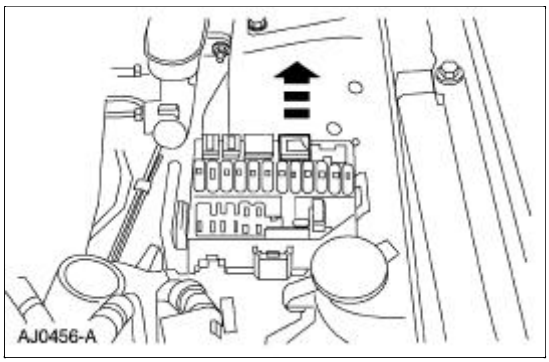


Relay Switch

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the power distribution box cover.



3. Remove the starter relay from the power distribution box.



Installation

1. To install, reverse the removal procedure.

Starter Motor —3.8L

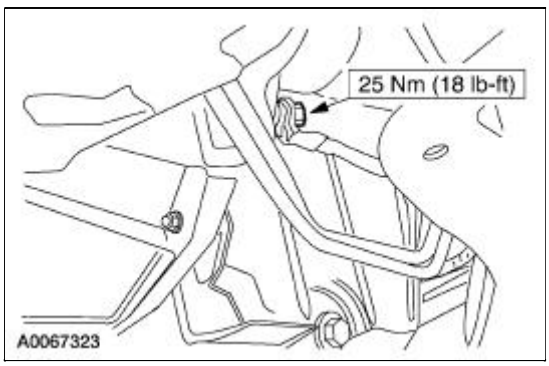
Removal

WARNING: When servicing starter motor (11002) or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid (11390) is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions may result in personal injury.

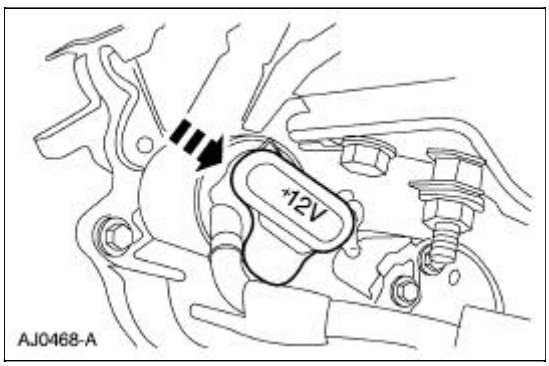
WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components. Failure to follow these instructions may result in personal injury.

NOTE: When working on the starter system, make sure the anti-theft system is deactivated (if equipped.)

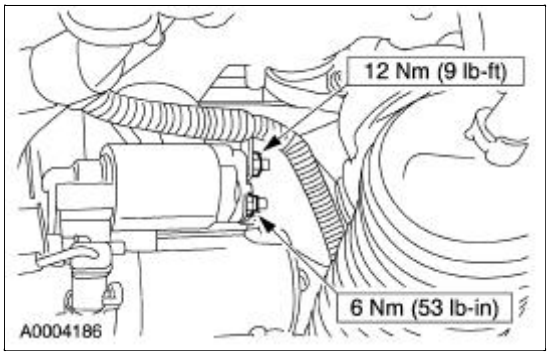
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the ground cable nut.



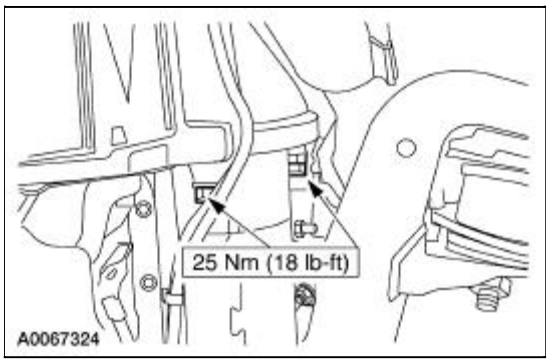
4. Remove the cap.



5. Remove the nuts and position aside the wires.



6. Remove the bolts and the starter motor.



Installation

1. To install, reverse the removal procedure.

Starter Motor —4.6L

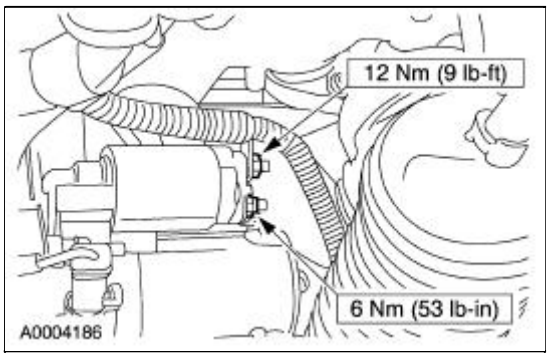
Removal

WARNING: When servicing starter motor (11002) or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid (11390) is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions can result in personal injury.

WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components. Failure to follow these instructions can result in personal injury.

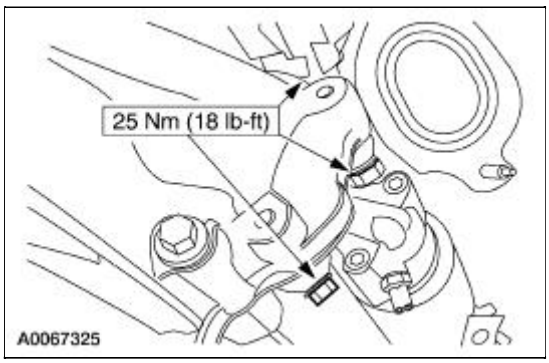
NOTE: When working on the starter system, make sure the anti-theft system is deactivated (if equipped.)

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the red starter solenoid safety cap.
4. Remove the starter solenoid nuts and position aside the wires.



5. **NOTE:** To ease removal, remove the upper, concealed bolt first.

   Remove the three starter motor bolts.

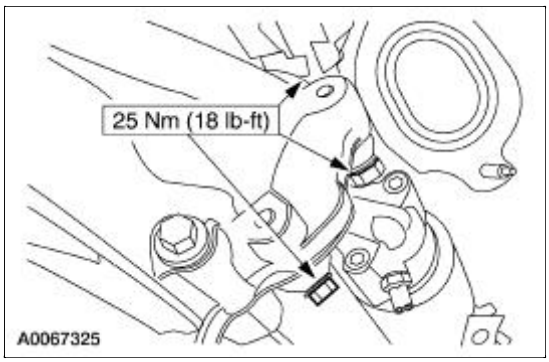


6. Remove the starter motor.

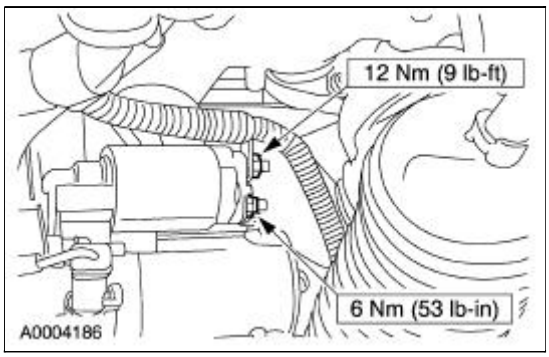
Installation

1. Position the starter motor to the engine.
2. **NOTE:** To ease installation, first install the two lower bolts finger tight, then install the upper, concealed bolt. Tighten all three bolts to specification.

   Install the three starter motor bolts.



3. Connect the starter motor solenoid and starter motor cable connections.



4. Install the red starter solenoid safety cap.
5. Lower the vehicle.
6. Connect the battery ground cable.